MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

ERT2016 – ENGINEERING MECHANICS

(RE)

5 JULY 2023

9.00 a.m.– 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 8 pages including the cover page and a table.
2. Choose FOUR out of FIVE questions to answer.
3. The distribution of the marks for each question is given.
4. Please write all your answers in the answer booklet provided. All necessary workings **MUST** be shown.

Question 1

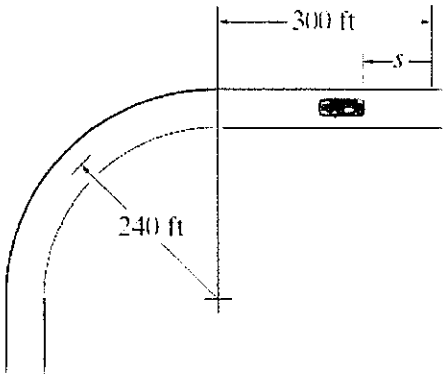


Figure 1

a) A race car is originally at rest. It then starts to increase its speed at $\frac{dv}{dt} = 0.05t^2$, where t is in seconds. Determine the magnitude of its velocity and acceleration at s = 550 ft. Leave your answer in ft/s for velocity and ft/s^2 for acceleration.

[12 marks]

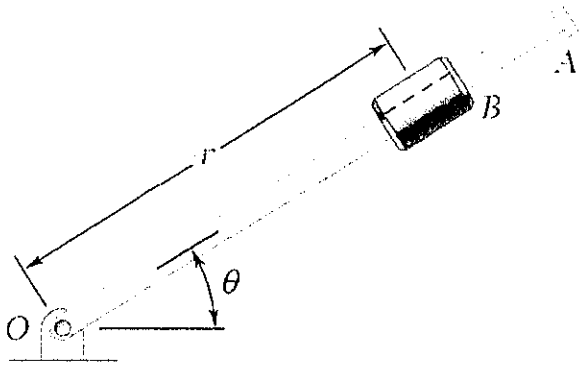


Figure 2

b) Rotation of the a radially slotted arm is governed by $r = \sqrt{4sin\left(\frac{\theta}{2}\right)}$

Continued...

Simultaneously, the power screw in the arm engages the slider B and controls its distance from O. In the other words, when the slotted arm moves in angular motion, the slider B is able to move along the axis *OA*.

Arm OA rotates counterclockwise with a constant angular velocity of $\dot{\theta} = 2$ rad/s, determine the magnitudes of the velocity and acceleration of the slider B at $\theta = 30°$.

a) velocity(v_r and v_θ)

b) acceleration(a_r and a_θ) [7 + 6 marks]

Question 2

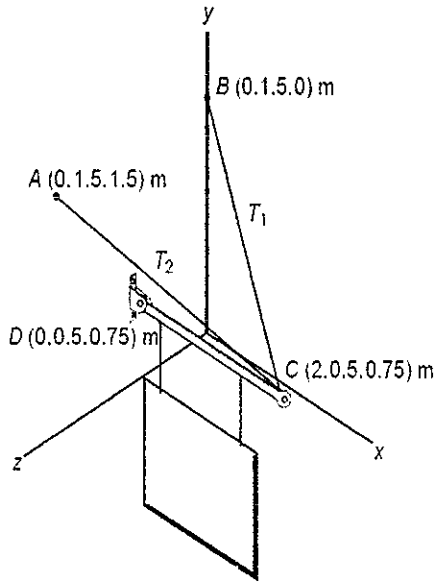


Figure 3

a) The sign's weight applies a force of 600N downwards (-y) at point E, which is located 0.25m from D, and at point F, which is located 1.75m from D. Determine,

i) the reactions at the ball and socket support located at point D. [6 marks]

ii) the tensions in the support ropes (T_1 and T_2) for the sign support system.

[6 marks]

Continued...

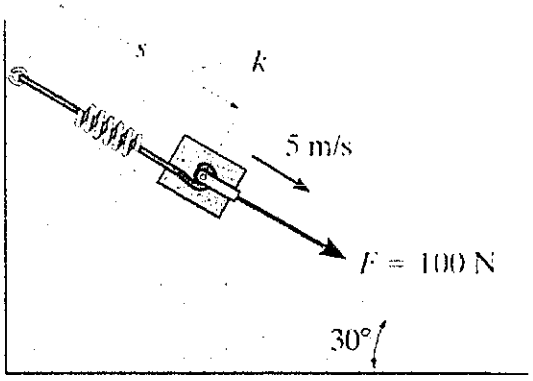


Figure 4

b) As shown in Fig.4, an 10-kg block is attached to a spring with spring constant k = 150 N/m. At the instant shown, the spring is not stretched. A force of 100N is applied to the block, parallel to the slope, and the block has a speed of 5 m/s down the smooth lane. Determine the distance the object will travel before it comes to a stop if

i) the slope is smooth

ii) the kinetic friction coefficient between the slope and block is 0.22.

[7 + 6 marks]

Continued...

Question 3

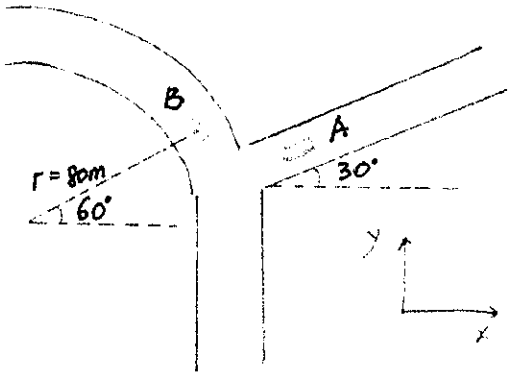


Figure 5

a) Cars A and B travel with speed of 20 m/s and 15 m/s at the instant shown in figure 5. At the same instant, car A has an acceleration of 2 m/s2. Determine the velocity of car A with respect to car B. [12 marks]

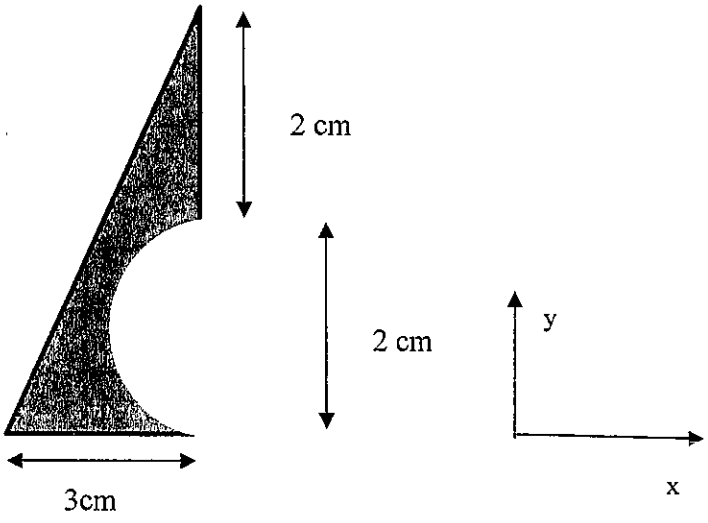
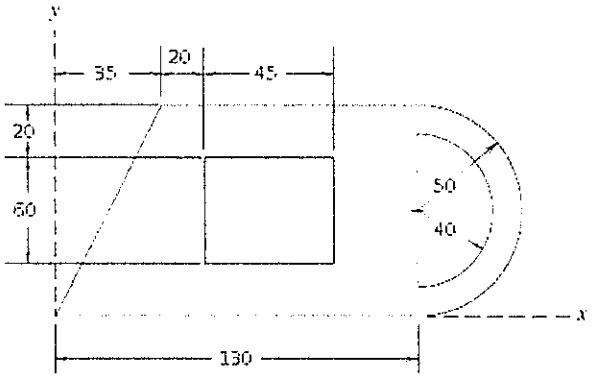


Figure 6

b) Refer to Figure 6. Determine the moment inertia about the x-axis and y-axis. [13 marks]

Continued...

Question 4



Dimensions in millimeters

Figure 7

a) Refer to Figure 7. Determine the coordinates of the centroid of the shaded area. [13 marks]

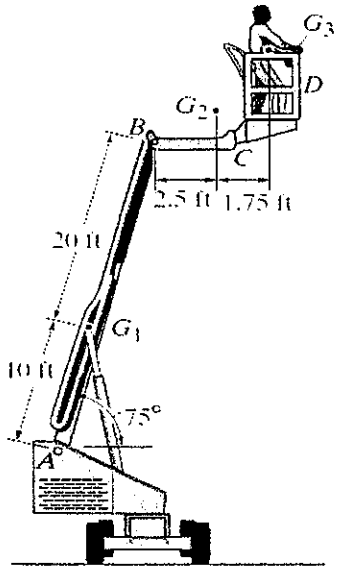


Figure 8

b) i) Calculate the total moment around point A generated by the 1500-lb boom AB, the 200-lb cage BCD, and the 175-lb man, whose centers of gravity are located at points G1, G2, and G3 respectively. Leave your answer in lb.ft [9 marks]

ii) As the system is in equilibrium, the moment at point A must be zero. What other forces, aside from those mentioned in (i), could potentially contribute to this equilibrium state? [3 marks]

Continued...

Question 5

a) Given a block with a mass of 5 kg, moving at a velocity of 4 m/s downwards, and located 10 meters above the sandy surface.

i) Calculate the impulse exerted by the sand on the block required to bring it to a complete stop. [8 marks]

ii) Calculate the mean force of the impulse applied by the sand on the block, given that the block's motion is arrested within 0.8 seconds after making contact with the sand. [5 marks]

Disregard any deformation of the sand due to the block and assume that the block does not bounce back.

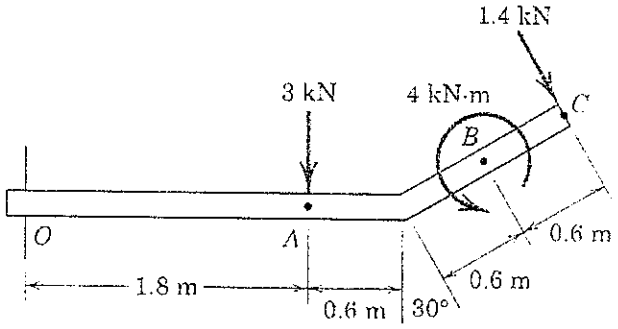


Figure 9

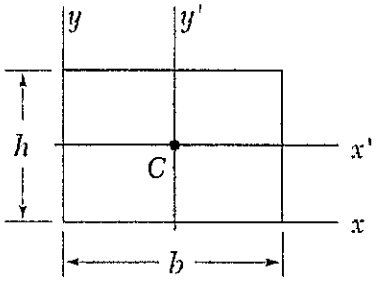
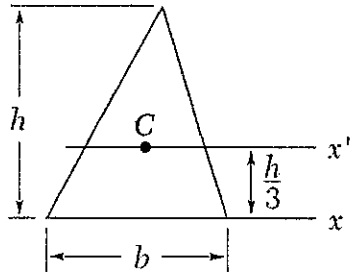
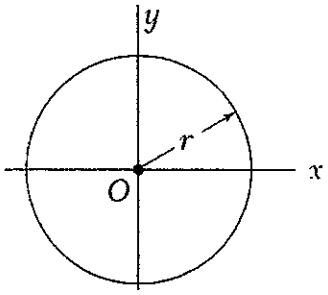
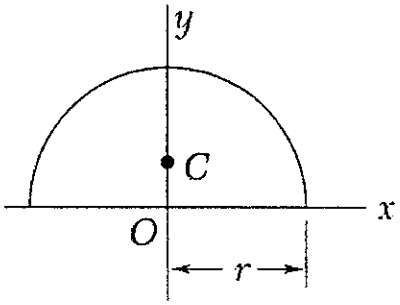
b) The uniform beam has a mass of 40kg per meter of length. The force loads shown lie in a vertical plane. Calculate

i) the reactions F_x and F_y at the support O. [7 marks]

ii) The moment at the support O. [5 marks]

End of page

Centroid and Moment of Inertia

		Moment of Inertia	Centroid
Rectangle		$I_{x'} = \frac{1}{12}bh^3$ $I_{y'} = \frac{1}{12}b^3h$ $I_x = \frac{1}{3}bh^3$ $I_y = \frac{1}{3}hb^3$	$\bar{x} = \frac{b}{2}$ $\bar{y} = \frac{h}{2}$
Triangle		$I_x = \frac{1}{12}bh^3$ $I_{x'} = \frac{1}{36}bh^3$	$\bar{x} = \frac{b}{3}$ $\bar{y} = \frac{h}{3}$
Circle		$I_x = I_y = \frac{1}{4}\pi r^4$	$\bar{x} = 0, \quad \bar{y} = 0$
Semicircle		$I_x = 0.1098r^4$ $I_y = \frac{1}{8}\pi r^4$	$\bar{x} = 0$ $\bar{y} = \frac{4r}{3\pi}$